3	Setti	Setting-up and Running an Aircraft Model				4.2.9	Roll Moment Coefficient	60
	3.1	Aircra	ft Model Examples	27		4.2.10	Yaw Moment Coefficient	61
	3.2	Buildi	ng an aircraft configuration	28	4.3	Atmos	phere	62
		3.2.1	Conventions	28		4.3.1	Standard Atmosphere	63
		3.2.2	Section 1: Aerodynamics	28		4.3.2	Background Wind	
		3.2.3	Section 2: Propeller	29		4.3.3	Turbulence	65
		3.2.4	Section 3: Engine	30		4.3.4	Wind Shear	66
		3.2.5	Section 4: Inertia			4.3.5	Wind Force	67
		3.2.6	Section 5: Other parameters	31		4.3.6	Wind Moment	68
	3.3	The pr	e-built Aircraft Models	32	4.4	Compl	ete Aircraft	69
	3.4		FlightGear Aircraft Configuration Files			4.4.1	6-DOF Aircraft Model - body-frame EOM	70
		3.4.1	The JSBSim XML Configuration File			4.4.2	6-DOF Aircraft Model - geodetic-frame EOM	1 73
		3.4.2	The xml Aircraft Parser	36		4.4.3	6-DOF Aircraft Model - geodetic-frame EOM	[,
		3.4.3	The Matlab Aircraft Structure	37			no magnetic field	76
	3.5	Additi	onal Matlab Utilities	40		4.4.4	Simple Aircraft Model	79
						4.4.5	Glider Model	81
4	Bloc	Block Reference				4.4.6	Inertial Navigation System	83
	4.1	Actuat	tors		4.5	Earth.		84
		4.1.1	Simple Actuator (1st-order dynamics)	43		4.5.1	WGS-84	85
		4.1.2	Simple Actuator (2nd-order dynamics)			4.5.2	EGM-96	86
		4.1.3	D/A Converter	46		4.5.3	Ground Detection	87
	4.2	Aerod	ynamics			4.5.4	WMM-2000	88
		4.2.1	Aerodynamic Force		4.6	Equation	ons of Motion	89
		4.2.2	Aerodynamic Moment	49		4.6.1	Total Acceleration	90
		4.2.3	Wind-axes Velocities	50		4.6.2	Total Moment	91
		4.2.4	Dynamic Pressure	52		4.6.3	Body-frame EOM: Forces	92
		4.2.5	Lift Coefficient	53		4.6.4	Body-frame EOM: Moments	93
		4.2.6	Drag Coefficient			4.6.5	Body-frame EOM: Kinematics (Quaternions)	94
		4.2.7	Side Force coefficient	57		4.6.6	Body-frame EOM: Kinematics (Euler An-	
		4.2.8	Pitch Moment Coefficient	58			gles)	95

	4.6.7	Body-frame EOM: Navigation 96		4.11.3	Simple Sensor - 1st-order dynamics 135
	4.6.8	Geodetic-frame EOM: Position 98			Simple Sensor - 2nd-order dynamics 136
	4.6.9	Geodetic-frame EOM: Velocity 100			Analog Sensor
	4.6.10	Geodetic-frame EOM; Attitude (Quaternions) 102			A/D Converter
		Geodetic-frame EOM: Attitude (Euler An-			Single GPS Measurement 139
		gles)			GPS PV
	4.6.12	Geodetic-frame EOM; Angular Rate 104	4.12	Transfo	rmations
4.7	Inertia			4.12.1	Body-Inertial DCM From Quaternions 142
	4.7.1	Aircraft Inertia 107		4.12.2	Body-Inertial DCM From Euler Angles 143
	4.7.2	Inertia Coefficients 109		4.12.3	Body-Wind DCM 144
4.8	Math.			4.12.4	Euler Angles From Quaternions 145
	4.8.1	Cross Product		4.12.5	Euler Angles from DCM 146
	4.8.2	Normalization		4.12.6	Quaternions From Euler Angles 147
	4.8.3	Vector Norm		4.12.7	ECEF Position
	4.8.4	Non-zero Sign	4.13	Unit Co	onversion
	4.8.5	Zero Offset		4.13.1	Angular position: Deg 2 rad and Rad 2 deg 150
	4.8.6	pi Bound		4.13.2	Angular velocity: Rad/s 2 RPM and RPM
	4.8.7	2pi Bound			2 rad/s
4.9	Pilot In	nterface		4.13.3	Distance: ft 2 m and m 2 ft 152
	4.9.1	FS Interface		4.13.4	Distance: m 2 nm and nm to m 153
	4.9.2	FlightGear Interface		4.13.5	Velocity: m/s 2 km/h and km/h 2 m/s 154
	4.9.3	Joystick Interface		4.13.6	Velocity: m/s 2 mph and mph 2 m/s 155
	4.9.4	CH F-16 Combat Stick 124			Velocity: m/s 2 kts and kts 2 m/s 156
4.10	Propuls	sion		4.13.8	Force: lbf 2 N and N 2 lbf $\dots \dots 157$
	4.10.1	Fixed-Pitch Propeller 127		4.13.9	Mass: lb 2 kg and kg 2 lb 158
	4.10.2	Piston Engine		4.13.10	Mass: slug 2 kg and kg 2 slug 159
	4.10.3	GA Propulsion System 130		4.13.11	Volume: gal 21 and 12 gal 160
4.11		s			Pressure: Pa 2 in.Hg. and in.Hg. 2 Pa 161
	4.11.1	Noise Correlation: Random Walk 133		4.13.13	Temperature: K 2 F and F 2 K 162
	4.11.2	Noise Correlation: Gauss-Markov Process . 134	4.14	FlightG	ear-Compatible

4.14.1	Inertia: Empty Aircraft 164
4.14.2	Inertia: Point Mass 165
4.14.3	Propulsion: FG Piston Engine + Fixed-
	Pitch Prop
4.14.4	Propulsion: FG Piston Engine + Variable-
	Pitch Prop
4.14.5	Piston Engine: Intake Model 170
4.14.6	Piston Engine: AirFlow Model 171
	Piston Engine: FuelFlow Model 172
4.14.8	Piston Engine: Power Model 173
4.14.9	Piston Engine: FG Piston Engine 174
4.14.10	Propeller Thruster: FG Fixed-Pitch Propeller 175
4.14.11	Propeller Thruster: FG Variable-Pitch Pro-
	peller
4.14.12	Tank: Fuel Tank 177
4.14.13	Aerodynamics: Value 178
4.14.14	Aerodynamics: Vector 179
4.14.15	Aerodynamics: Table 180
	Aerodynamics: Coefficient 181
4.14.17	Complete Aircraft: Cessna-172 182
4.14.18	Complete Aircraft: Cessna-182 184
4.14.19	Complete Aircraft: Cessna-310 186